

**SKILLS FRAMEWORK FOR PRECISION ENGINEERING  
TECHNICAL SKILLS AND COMPETENCIES (TSC) REFERENCE DOCUMENT**

<b>TSC Category</b>	Engineering and Manufacturing Fundamentals					
<b>TSC</b>	Polymeric Material Characterisation					
<b>TSC Description</b>	Conduct tests and measurement taking to evaluate suitability of polymeric materials for uses in manufacturing					
<b>TSC Proficiency Description</b>	<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>	<b>Level 4</b>	<b>Level 5</b>	<b>Level 6</b>
			<b>PRE-ACE-3029-1.1</b>	<b>PRE-ACE-4029-1.1</b>	<b>PRE-ACE-5029-1.1</b>	
			Conduct experiments to determine material properties to facilitate selection and application of commodity and engineering polymers	Evaluate and characterise polymers and composite materials through theoretical and computational modelling	Characterise and assess the suitability of advanced composite materials (AMCs) and other unconventional polymers for manufacturing components	
<b>Knowledge</b>			<ul style="list-style-type: none"> <li>• Polymerisation processes</li> <li>• Effects of molecular weight on material properties</li> <li>• Polymer structures</li> <li>• Morphology of thermoplastic materials</li> <li>• Viscosity of polymer materials</li> <li>• Effects of temperature and strain rate on the tensile and impact properties of polymer materials</li> <li>• Differences between commodity and engineering polymers</li> <li>• Types of plastics, additives and applications used in product manufacturing</li> <li>• Applications of fillers and fibres in thermoplastic materials</li> <li>• Procedures to examine tensile, melt flow index, heat deflection and thermal properties of polymer materials</li> </ul>	<ul style="list-style-type: none"> <li>• Concept, properties and performance characterisations of composite materials</li> <li>• Concepts of fibre critical length and rule of mixtures</li> <li>• Methodology of composite structure designs</li> <li>• Roles of matrices and reinforcement in composites</li> <li>• Interfacial adhesion mechanisms between matrix and fibre reinforcements</li> <li>• Types of polymer additives and their effects on modified polymeric materials</li> <li>• Definitions and properties of biopolymers and biocomposites</li> <li>• Definitions and properties of thermoplastic and thermosetting polymers</li> <li>• Rules and methods for designing polymers and fibre reinforced polymer composites</li> </ul>	<ul style="list-style-type: none"> <li>• Principles of precision engineering</li> <li>• Types, properties and applications of AMCs</li> <li>• Types, properties and applications of biomaterials, liquid crystals and liquid-crystal polymers</li> <li>• Methods for measuring mechanical properties</li> <li>• Methods for measuring thermal properties</li> <li>• Methods for measuring optical properties</li> <li>• Methods for measuring chemical properties, corrosion and microstructure characteristics</li> <li>• Methods to relate material property measurements to component requirements</li> </ul>	

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				<ul style="list-style-type: none"> <li>• Finite element method (FEM) and its application in structural, stress and failure criteria analyses</li> <li>• Techniques to characterise polymeric materials</li> </ul>		
<b>Abilities</b>			<ul style="list-style-type: none"> <li>• Assess polymerisation methods for suitability to manufacturing job</li> <li>• Analyse how molecular weight and polymer structure can affect material properties</li> <li>• Evaluate factors affecting material viscosity for impact on manufacturing strategies</li> <li>• Distinguish the differences between commodity and engineering polymers</li> <li>• Evaluate changes in properties associated with adding fillers and fibres to thermoplastic materials</li> <li>• Examine tensile, melt flow index, heat deflection and thermal properties of polymer materials</li> <li>• Carry out testing for different plastics, in accordance with standard procedures</li> </ul>	<ul style="list-style-type: none"> <li>• Perform finite element analyses on polymers and composite materials, and analyse material responses and behaviours under different mechanical and thermal loadings</li> <li>• Perform finite element analyses on materials and apply external loads to determine stress states and establish failure criteria properties</li> <li>• Establish structure-property relationships of materials, based on results of theoretical and computational modelling</li> <li>• Measure characteristics of polymer and composite materials, using appropriate methods and instruments</li> <li>• Recommend and report on materials selected</li> <li>• Enhance polymeric material characteristics by refining polymeric parameters through finite element modelling, to exceed requirements</li> <li>• Evaluate the effects of adding additives for possibilities to exceed requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Review the required properties of products, parts and/or components to shortlist the range of metals that can meet requirements</li> <li>• Measure mechanical and electrical properties of selected materials for suitability assessment</li> <li>• Measure thermal properties of selected materials for suitability assessment</li> <li>• Measure optical properties of selected materials for suitability assessment</li> <li>• Measure chemical properties, corrosion and microstructure characteristics of selected materials for suitability assessment</li> <li>• Analyse measurements to determine characteristics of materials</li> <li>• Assess the suitability of materials in accordance with requirements</li> <li>• Apply systematic approaches to materials characterisation processes, to facilitate knowledge management and optimisation</li> </ul>	